Recent and Possible Future Changes in Permafrost

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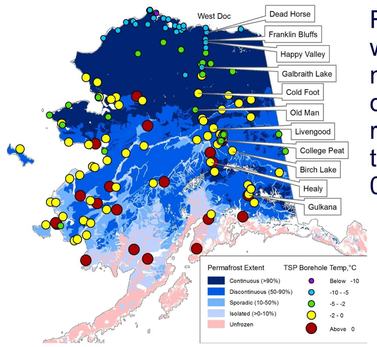
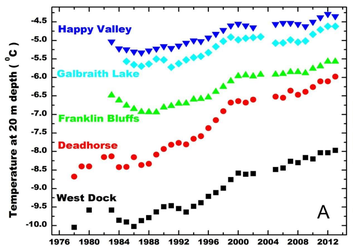
Recent Trends in Permafrost



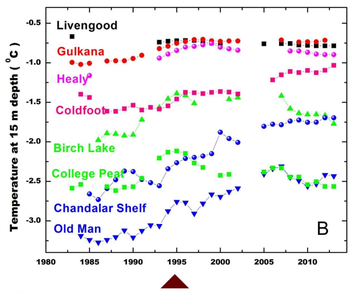
Recent observations indicate a warming of permafrost in many northern regions with the resulting degradation of ice-rich and carbon-rich permafrost. Permafrost temperature has increased by 0.5°C to 3°C in the northern Hemisphere during the last 30-40 years (*Romanovsky et al., 2010*).

Permafrost Distribution in Alaska and Permafrost Observatories Location

"TSP" Time Series - Northern Alaska



"TSP" Time Series - Interior Alaska



Permafrost temperature trends across northern (A) and interior (B) Alaska.

Performance of a very high quality (precision generally at 0.01°C) temperature measurements in shalow and deep boreholes across Alaska from north to south.

The most significant impacts on ecosystems, infrastructure, carbon cycle and hydrology will be observed in areas where permafrost contains a considerable amount of ground ice in the upper few meters.

Active layer depth is increasing at some locations. There are some locations in the West Siberia where active layer does not refreeze completely every year anymore. The long-term permafrost thawing already started at some locations in natural undisturbed conditions.

Kolyma River, northeast Siberia, Russia.

Ice-rich permafrost, interior Alaska, Fairbanks vicinity.

Impact on Ecosystems

Pounding, thermokarst development.

Collapsing of the ground surface due to ground ice melting.

Slope Instability. Active Layer Detachment.

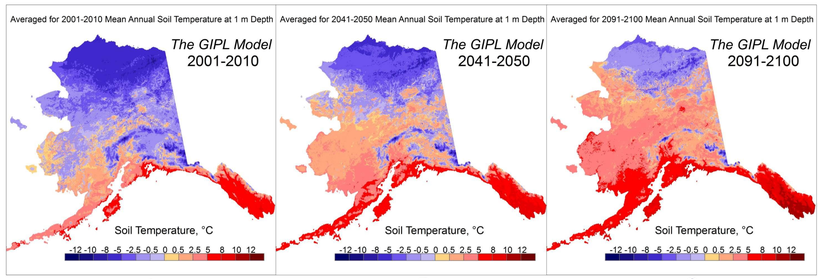
Impact on Infrastructure

Permafrost thawing is already causing serious damage to buildings and industrial facilities and is projected to continue.

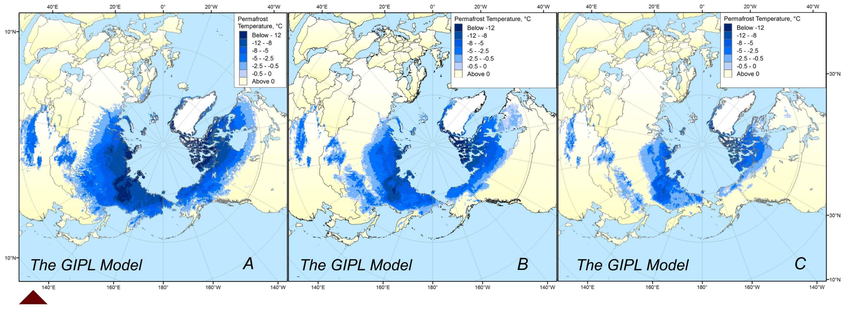
Building located in Chersky, East Siberia, is collapsing.

Permafrost Dynamics Modeling usin GIPL

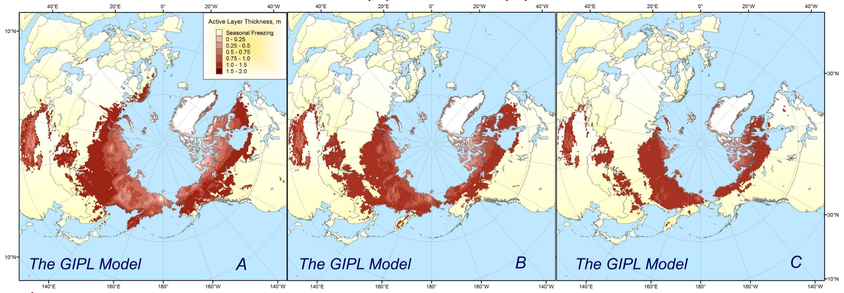
The **GIPL** model was developed in the ***G**eophysical **I**nstitute **P**ermafrost **L**ab* specifically to assess the effect of a changing climate on permafrost.



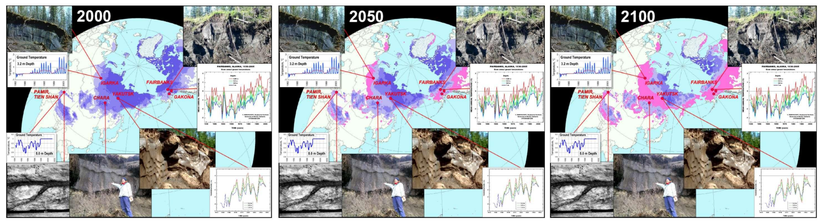
2 by 2 km spatial resolution modeled map of ground temperature at 1 m depth and permafrost distribution averaged for 2001-2010(A), 2041-2050(B), and 2091-2100(C)



Permafrost temperature at 2.0 m depth across the northern Hemisphere for 2010 (A), 2050 (B), and 2100 (C).



Permafrost area with active layer thickness not deeper than 2.0 m across the northern Hemisphere for 2000 (A), 2050 (B), and 2100 (C)



According to the IPCC SRES A1B CO_2 emission scenario through the end of current century the ice-rich permafrost may be actively thawing at all locations in natural undisturbed conditions across the entire northern Hemisphere.